

AMENDMENTS

In the Claims

Please amend the claims as follows:

E¹ Sub F-2 }
13. (Thrice Amended) A system for performing PCR and monitoring the reaction during temperature cycling comprising;
a sample container for holding a PCR sample, the sample container comprising an optically clear material, the sample container formed for holding less than 1 milliliter of a sample and having a first side, a second side, and an end;
means for positioning the PCR sample container in a monitoring position;
means for heating the PCR sample;
means for cooling the PCR sample;
control means for repeatedly operating the means for heating and the means for cooling to subject the PCR sample to thermal cycling;
means for optically exciting the to cause the sample to fluoresce; and
means for detecting the fluorescence of the excited sample during amplification when the sample is in the monitoring position.

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14. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 further comprising:
means for determining at least one reaction parameter in accordance with the detected fluorescence.

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15. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 14 further comprising means for adjusting the control means in accordance with the reaction parameter.

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16. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 15 in which the control means adjusts the operation of the means for heating and the means for cooling to alter the times the means for heating and the means for cooling operate in accordance with the reaction parameter.

17. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 15 in which the control means adjusts the operation of the means for heating and the means for cooling to alter the rate at which the biological sample is heated and cooled in accordance with the reaction parameter.

18. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the sample container is fabricated at least partially from glass, the sample container having a volume not greater than about 10,000 .

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19. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the means for positioning the PCR sample container in a monitoring position comprises a rotatable carousel.

20. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 further comprising means for positioning the means for optically exciting the sample and the means for detecting the fluorescence of excited sample to optimize the fluorescence which is detected.

21. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the means for heating the PCR sample comprises a forced air heater.

22. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the means for cooling comprises an air movement mechanism which transports ambient air to the sample container.

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23. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the control means comprises a microprocessor.

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24. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the means for optically exciting the sample comprises a photo emitter structure positioned so that the radiation emitted therefrom impinges the first side of the sample container.

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25. (Thrice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 24 wherein means for detecting the fluorescence of the excited sample comprises a photo detector structure positioned so that the radiation emitted from the second side of the sample container is detected.

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26. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the means for optically exciting the sample comprises a photo emitter structure positioned so that the radiation emitted therefrom impinges the end of the sample container.

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27. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 26 wherein the means for detecting the fluorescence of the excited sample comprises a photo detector structure positioned so that the radiation emitted from the end of the sample container is detected.

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28. (Thrice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 14 wherein the means for determining

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at least one reaction parameter in accordance with the detected fluorescence comprises means for determining at least one reaction parameter selected from the group consisting of: product melting temperature, product melting time, product reannealing temperature, product reannealing time, probe melting time, primer annealing/extension temperature, and primer annealing/extension time.

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29. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the control means comprises means cooling the sample when the means for detecting the fluorescence of the excited sample detects that the product is completely melted.

30. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the control means comprises means for heating the sample when the means for detecting the fluorescence of the excited sample detects no more product generation.

31. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the means for optically exciting is positioned to interact with the first side of the sample container and the means for detecting the fluorescence is positioned to interact with the second side of the sample container.

32. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 13 wherein the means for optically exciting is positioned to interact with the end of the sample container and the means for detecting the fluorescence is positioned to interact with the end of the sample container.

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82. (Twice Amended) A device for conducting PCR reactions, said device comprising a chamber;

a heater and a fan mounted in said device and in air flow communication with the chamber;

a carousel for holding a plurality of sample vessels, said carousel being rotatably mounted in said chamber;

each of said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the first dimension is less than the second dimension and wherein the ratio of volume to external surface area of each of said sample vessels is less than 1mm;

a light emitting source mounted in said chamber and positioned to illuminate at least one selected sample vessel along an axis substantially parallel to a wall along the second dimension of the selected sample vessel; and

a light detector mounted in said chamber and positioned to measure fluorescence from the selected sample vessel along an axis substantially parallel to a wall along the second dimension of the selected sample vessel.

87. (Thrice Amended) A system for performing PCR and monitoring the reaction comprising;

a chamber;

a heater and a fan in air flow communication with the chamber and a controller for cycling the temperature in the chamber according to initial predefined temperature and time parameters;

a carousel for holding a plurality of sample vessels said carousel being rotatably mounted in said chamber, said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the

first dimension is less than the second dimension and wherein the ratio of volume to external surface area of the vessel is less than 1mm;

a light emitting source mounted in said chamber and positioned to illuminate at least one of the sample vessels along an axis substantially parallel to a wall along the second dimension of the vessel;

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a light detector mounted in said chamber and positioned to measure fluorescence from at least one of the sample vessels along an axis substantially parallel to a wall along the second dimension of the vessel; and

means for displaying the status of the reaction based on detected fluorescence.

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121. (Amended) A device for conducting PCR reactions, said device comprising

a chamber;

a heater and a fan mounted in said device and in air flow communication with the chamber;

a carousel for holding a plurality of sample vessels, said carousel being rotatably mounted in said chamber;

said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the first dimension is less than the second dimension and wherein the ratio of volume to external surface area of each of said sample vessels is less than 1mm;

a light emitting source positioned to illuminate at least one selected sample vessel along an axis substantially parallel to a wall along the second dimension of the selected sample vessel; and

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a light detector positioned to measure fluorescence from the selected sample vessel along an axis substantially parallel to a wall along the second dimension of the selected sample vessel.

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122. (Twice Amended) A system for performing PCR and monitoring the reaction comprising:

- a chamber;
- a heater and a fan in air flow communication with the chamber and a controller for cycling the temperature in the chamber according to initial predefined temperature and time parameters;
- a carousel for holding a plurality of sample vessels said carousel being rotatably mounted in said chamber, said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the first dimension is less than the second dimension and wherein the ratio of volume to external surface area of the vessel is less than 1mm;
- a light emitting source positioned to illuminate at least one of the sample vessels along an axis substantially parallel to a wall along the second dimension of the vessel;
- a light detector positioned to measure fluorescence from at least one of the sample vessels along an axis substantially parallel to a wall along the second dimension of the vessel; and
- means for displaying the status of the reaction based detected fluorescence.

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128. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling comprising;

a sample container for holding a PCR sample, the sample container comprising an optically clear material, the sample container formed for holding less than 1 milliliter of a sample and having a first side, a second side, and an end;

means for positioning the PCR sample container in a monitoring position;

means for heating the PCR sample;

means for cooling the PCR sample;

control means for repeatedly operating the means for heating and the means for cooling to subject the PCR sample to thermal cycling;

means for optically exciting the sample to cause the sample to fluoresce;

means for detecting the fluorescence of the excited sample during amplification when the sample container is in the monitoring position;

means for determining at least one reaction parameter in accordance with the detected fluorescence; and

means for adjusting the control means in accordance with the reaction parameter.

129. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 in which the control means adjusts the operation of the means for heating and the means for cooling to alter the times the means for heating and the means for cooling operate in accordance with the reaction parameter.

130. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 in which the control means adjusts the operation of the means for heating and the means for cooling to alter the rate at which the biological sample is heated and cooled in accordance with the reaction parameter.

131. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for positioning the PCR sample container in a monitoring position comprises a rotatable carousel.

132. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 further comprising means for positioning the means for optically exciting the sample and the means for detecting the fluorescence of excited sample to optimize the fluorescence which is detected.

133. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for heating the PCR sample comprises a forced air heater.

134. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for cooling comprises an air movement mechanism which transports ambient air to the sample container.

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and
135. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the control means comprises a microprocessor.

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136. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for optically exciting the sample comprises a photo emitter structure positioned so that the radiation emitted therefrom impinges the first side of the sample container.

137. (Twice Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 136 wherein means for detecting the fluorescence of the excited sample comprises a photo detector structure positioned so that the radiation emitted from the second side of the sample container is detected.

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138. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for optically exciting the sample comprises a photo emitter structure positioned so that the radiation emitted therefrom impinges the end of the sample container.

139. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 138 wherein the means for detecting the fluorescence of the excited sample comprises a photo detector structure positioned so that the radiation emitted from the end of the sample container is detected.

140. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for determining at least one reaction parameter in accordance with the detected fluorescence comprises means for determining at least one reaction parameter selected from the group consisting of: product melting temperature, product melting time, product reannealing temperature, product reannealing time, probe melting time, primer annealing/extension temperature, and primer annealing/extension time.

141. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the control means comprises means cooling the sample when the means for detecting the fluorescence of the excited sample detects that the product is completely melted.

142. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the control means comprises means for heating the sample when the means for detecting the fluorescence of the excited sample detects no more product generation.

143. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for optically exciting is positioned to interact with the first side of the sample container and the means for detecting the fluorescence is positioned to interact with the second side of the sample container.

144. (Amended) A system for performing PCR and monitoring the reaction during temperature cycling as defined in claim 128 wherein the means for optically exciting is positioned to interact with the end of the sample container and the means for detecting the fluorescence is also positioned to interact with the end of the sample container.

152. (Twice Amended) A system for performing PCR and monitoring the reaction comprising:

a chamber;

a heater and a fan in air flow communication with the chamber and a controller for cycling the temperature in the chamber according to initial predefined temperature and time parameters;

a carousel for holding a plurality of sample vessels said carousel being rotatably mounted in said chamber; the carousel comprising a disc having a top surface, a bottom surface, and an outer edge extending therebetween, a sample receiving port in the top surface, a sample vessel port in the outer edge, and a sample passageway communicating with said sample receiving port and the sample vessel port, said sample vessel port and passageway formed for receiving and fixing a sample vessel to the disc; the passageway including a barrier that prevents a liquid sample delivered through the sample receiving port from flowing to the sample vessel port absent a biasing force on said liquid sample;

said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the first dimension is

less than the second dimension and wherein the ratio of volume to external surface area of the vessel is less than 1mm;

a light emitting source positioned to illuminate at least one of the sample vessels along an axis substantially parallel to a wall along the second dimension of the vessel;

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a light detector positioned to measure fluorescence from at least one of the sample vessels along an axis substantially parallel to a wall along the second dimension of the vessel; and

a display for displaying the status of the reaction based detected fluorescence.

Please add the following claims:

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157. (New) The system of claim 13 wherein the means for detecting the fluorescence of the excited sample during amplification detects fluorescence throughout temperature cycling.

158. (New) The system of claim 13 wherein the means for detecting the fluorescence of the excited sample during amplification detects fluorescence during an extension or combined annealing/extension phase of temperature cycling.

REMARKS

The applicants thank the Examiner for telephonic interviews with the undersigned on May 9 and June 11, 2001. The applicants believe that the telephonic interviews were helpful in advancing the present application.

Claims 13-32, 82, 87, 121-122, 128-144, and 152 have been amended. Claims 157 and 158 have been added. Claims 13-35, 55-59, 79-82, 87-92, and 118-158 are now